

Claims:

1. A leadframe for use in a integrated circuit package, the leadframe comprising:
  - a frame lying in a first plane;
  - a plurality of leads disposed substantially in the first plane, each of said leads having an end attached to the frame;
  - a die paddle lying in a second plane which is substantially parallel to the first plane and is offset from the first plane by a given distance;
  - first and second support members that are connected between one end of the die paddle and the frame, the first and second support members being in the same plane as each other and being substantially parallel to the end of the die paddle to which they are connected; and
  - third and fourth support members that are connected between the other end of the die paddle and the frame, the third and fourth support members being in the same plane as each other and being substantially parallel to the end of the die paddle to which they are connected.
2. The leadframe of claim 1, wherein an offset angle is formed between the plane of the first and second support members and a line that is perpendicular to the first plane where the first member is connected to the die paddle, the offset angle being less than 45 degrees.
3. The leadframe of claim 2, wherein the offset angle is less than 30 degrees.
4. The leadframe of claim 2, wherein the offset angle is less than 20 degrees.

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5. The leadfreame of claim 2, wherein the offset angle is less than 10 degrees.

6. The leadfreame of claim 2, wherein the offset angle is less than 5 degrees.

7. The leadfreame of claim 2, wherein the offset angle is less than 0 degrees.

8. The leadframe of claim 1, further comprising:

an integrated circuit die;  
at least one bond pad mounted to said die; and  
a bond wire mounted between said bond pad and the frame.

9. A leadframe for an integrated circuit, comprising:

a frame having a plurality of sides defining an interior portion of the frame, at least a portion of the frame lying in an upper horizontal plane, the horizontal plane defining a vertical axis perpendicular thereto;

a plurality of leads, each of the plurality of leads having an outer end attached to the frame and an inner end within the interior portion, at least one of the plurality of leads disposed substantially along the upper horizontal plane;

a die paddle, at least a portion of the die paddle lying in a lower horizontal plane within the interior portion;

a first support member connecting the frame to the die paddle, the first support member having a proximal end and a distal end defining a first line segment therebetween, wherein the proximal end is connected to the frame on a first side thereof at a first

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frame attach point, wherein the distal end is connected to the die paddle at a first die paddle attach point, the first side of the frame defining a horizontal axis perpendicular thereto; wherein

an offset angle between the first line segment and the vertical axis, projected onto a first vertical plane that is parallel to the horizontal axis, is less than 45 degrees, wherein a positive offset angle corresponds to extension of the distal end of the first support member toward the interior portion.

10. The leadframe of claim 9 wherein the offset angle is less than 30 degrees.

11. The leadframe of claim 9 wherein the offset angle is less than 20 degrees.

12. The leadframe of claim 9 wherein the offset angle is less than 10 degrees.

13. The leadframe of claim 9 wherein the offset angle is less than 5 degrees.

14. The leadframe of claim 9 wherein the offset angle is less than 0 degrees, such that the distal end of the first support member, projected on the first vertical plane, extends away from the interior portion.

15. The leadframe of claim 9 wherein the first support member, projected on to a second vertical plane that is perpendicular to the first vertical plane, extends at a 45 degree angle from the vertical axis.

16. The leadframe of claim 15 wherein the distal end of the first support member extends away from

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the center of the interior portion in a projection on the second vertical plane.

17. The leadframe of claim 9 wherein the frame has a substantially rectangular shape.

18. The leadframe of claim 9 wherein the distal end of the first support member is connected to the die paddle proximate to a corner thereof.

19. The leadframe of claim 9 further comprising a second support member connected to the frame at a second frame attach point on the first side of the frame and connected to the die paddle at a second die paddle attach point opposite the first die paddle attach point, wherein the second support member, projected on to the second vertical plane, extends at a 45 degree angle from the vertical axis.

20. The leadframe of claim 9 further comprising a second support member connected to the frame at a second frame attach point on the side of the frame opposite the side on which the first frame attach point is located, and connected to the die paddle at a second die paddle attach point on the side of the die paddle opposite the side on which the first die paddle attach point is located, the second support member thereby connecting the frame to the die paddle.

21. The leadframe of claim 20 wherein the second support member has substantially the same shape as the first support member.

22. The leadframe of claim 19 further comprising third and fourth support members connected to

the frame on the side of the frame opposite the side on which the first and second frame attach points are located, wherein the third and fourth support members are each connected to the die paddle proximate to corresponding corners thereof, and wherein the pair of first and second support members and the pair of third and fourth support members are disposed symmetrically about a vertical plane of symmetry running through the center of the interior portion and perpendicular to the first vertical plane.

23. The leadframe of claim 9 wherein each of the plurality of leads lies along the upper horizontal plane for substantially the entire length of the lead.

24. The leadframe of claim 9 wherein substantially all of the frame lies on the upper horizontal plane and substantially all of the die paddle lies on the lower horizontal plane.

25. A leadframe for an integrated circuit, comprising:

a frame defining an interior portion thereof, at least a portion of the frame lying in an upper horizontal plane, the horizontal plane defining a vertical axis perpendicular thereto;

a plurality of leads, each of the plurality of leads having an outer end attached to the frame and an inner end within the interior portion;

a die paddle, at least a portion of the die paddle lying in a lower horizontal plane within the interior portion;

a first stem having a proximal end connected to a first side of the frame and a distal end lying in a

middle horizontal plane between the upper and lower horizontal planes, the first side of the frame defining a horizontal axis perpendicular thereto;

a first support member connecting the first stem to the die paddle, the first support member having a proximal end and a distal end defining a first line segment therebetween, wherein the proximal end is connected to the first stem at a first stem attach point, wherein the distal end is connected to the die paddle at a first die paddle attach point; wherein

the offset angle between the first line segment and the vertical axis, projected onto a first vertical plane that is parallel to the horizontal axis, is less than 45 degrees, wherein a positive offset angle corresponds to extension of the distal end of the first support member toward the interior portion.

26. The leadframe of claim 25 wherein the offset angle is less than 30 degrees.

27. The leadframe of claim 25 wherein the offset angle is less than 20 degrees.

28. The leadframe of claim 25 wherein the offset angle is less than 10 degrees.

29. The leadframe of claim 25 wherein the offset angle is less than 5 degrees.

30. The leadframe of claim 25 wherein the offset angle is less than 0 degrees, such that the distal end of the first support member, projected on the first vertical plane, extends away from the interior portion.

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31. The leadframe of claim 25 wherein the first support member, projected on to a second vertical plane that is perpendicular to the first vertical plane, extends at a 45 degree angle from the vertical axis.

32. The leadframe of claim 25 wherein the distal end of the first support member extends away from the center of the interior portion in a projection on the second vertical plane.

33. The leadframe of claim 25 wherein the frame has a substantially rectangular shape.

34. The leadframe of claim 25 wherein the distal end of the first support member is connected to the die paddle proximate to a corner thereof.

35. The leadframe of claim 25 further comprising a second support member connected to the first stem at a second stem attach point and connected to the die paddle at a second die paddle attach point opposite the first die paddle attach point, wherein the second support member, projected on to the second vertical plane, extends at a 45 degree angle from the vertical axis.

36. The leadframe of claim 25 further comprising:

a second stem with a proximate end and a distal end, wherein the proximate end of the second stem is connected to the frame on the side opposite of the side to which the first stem is attached, wherein the second stem and the first stem are disposed symmetrically about a vertical plane of symmetry running through the center

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of the interior portion and perpendicular to the horizontal axis;

third and fourth support members connected to the distal end of the second stem, wherein the third and fourth support members are each connected to the die paddle proximate to corresponding corners thereof, and wherein the pair of first and second support members and the pair of third and fourth support members are disposed symmetrically about the vertical plane of symmetry.

37. The leadframe of claim 25 wherein each of the plurality of leads lies along the upper horizontal plane for substantially the entire length of the lead.

38. The leadframe of claim 25 wherein substantially all of the frame lies on the upper horizontal plane and substantially all of the die paddle lies on the lower horizontal plane.

39. An integrated circuit package assembly comprising:

a leadframe comprising:

a frame defining an interior portion thereof, at least a portion of the frame lying in an upper horizontal plane;

a plurality of leads, each of the plurality of leads having an outer end attached to the frame and an inner end within the interior portion, at least one of the plurality of leads disposed substantially along the upper horizontal plane;

a die paddle, at least a portion of the die paddle lying in a lower horizontal plane within the interior portion;

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a first support member extending from a first side of the frame and connecting the frame to the die paddle, the first side defining a horizontal axis perpendicular thereto;

an integrated circuit die disposed on the die paddle, the die having a plurality of bond pads on an active face thereof;

a plurality of bond wires, each of the plurality of bond wires connecting a corresponding one of the plurality of bond pads to a corresponding one of the plurality of leads; wherein

wherein the offset between the die and the frame, as projected on to the horizontal axis, is less than 4 mils.

40. The semiconductor package assembly of claim 39 wherein the offset between the die and the frame, as projected on to the horizontal axis, is less than 3 mils.

41. The semiconductor package assembly of claim 39 wherein the offset between the die and the frame, as projected on to the horizontal axis, is less than 2 mils.

42. The semiconductor package assembly of claim 39 further comprising molding compound surrounding at least a portion of the leadframe and a portion of the die, wherein at least a portion of the face of the die paddle opposed to the face on which the die is mounted is not covered by the molding compound.

43. An integrated circuit package comprising:

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a frame having a plurality of sides defining an interior portion of the frame, at least a portion of the frame lying in an upper horizontal plane;

a plurality of leads, each of the plurality of leads having an outer end attached to the frame and an inner end within the interior portion, at least one of the plurality of leads disposed substantially along the upper horizontal plane;

a die paddle, at least a portion of the die paddle lying in a lower horizontal plane within the interior portion;

an integrated circuit die disposed on the die paddle, the die having a plurality of bond pads on an active face thereof;

a first support member connecting the frame to the die paddle, the first support member having a proximal end and a distal end, wherein the proximal end is connected to the frame on a first side thereof at a first frame attach point, wherein the distal end is connected to the die paddle at a first die paddle attach point;

a bond wire electrically connecting one of the bond pads on the die to the frame, wherein one end of the bond wire is attached to the frame at some point on the upper horizontal plane.

44. The semiconductor package assembly of claim 43 wherein another end of the bond wire is attached to the die, thereby forming a direct electrical connection between the die and the frame.

45. A leadframe for an integrated circuit, comprising:

a frame having a plurality of sides defining an interior portion of the frame, at least a portion of the frame lying in an upper horizontal plane;

a plurality of leads, each of the plurality of leads having an outer end attached to the frame and an inner end within the interior portion;

a die paddle, at least a portion of the die paddle lying in a lower horizontal plane within the interior portion;

a pair of support members connecting the frame to the die paddle, each of the pair of support members having a proximal end and a distal end, wherein the proximal end is connected to the frame on a first side thereof at a corresponding pair of frame attach points and wherein the distal end is connected to the die paddle at a corresponding die paddle attach point; wherein

the distal ends of the pair of support members extend away from a vertical plane that is perpendicular to the first side of the frame and that passes between the pair of support members.

458/123 46. A method for manufacturing a leadframe for an integrated circuit, the method comprising the steps of:

creating a substantially planar piece of metal characterized by a pattern, wherein the pattern defines a support member, a die paddle, and a frame;

moving a portion of the support member in a pure vertical direction such that the die paddle lies in a lower horizontal plane and the frame lies in an upper horizontal plane, wherein the support member connects the frame to the die paddle.